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1997-98 School Year

Biology 30 Information Bulletin

Diploma Examinations Program

Students First! Student Evaluation

Alberta
EDUCATION

This document was written primarily for:

Students	✓
Teachers	✓ Biology 30 teachers
Administrators	✓
Parents	
General Audience	
Others	

Distribution: Superintendents of Schools • School Principals and Teachers • The Alberta Teachers' Association • Alberta Education • General Public upon Request

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***Alberta educators** may reproduce this bulletin for **educational purposes**.*

This document can be found on our Web pages. Our Internet address is http://ednet.edc.gov.ab.ca.

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Purpose of the Bulletin

The purpose of this bulletin is to provide students and teachers of Biology 30 with information about the diploma examinations scheduled for the 1997–98 school year.

This bulletin includes descriptions of the Biology 30 diploma examinations, that will be administered in January, April, June, and August of 1998, descriptions of the acceptable standard and the standard of excellence, and subject specific information.

Teachers are encouraged to share the contents of this bulletin with students.

As well, the publication *Students First: A Guide for Students Preparing to Write the Biology 30 Diploma Examination* contains significant information for students.

The document entitled *General Information Bulletin, Diploma Examinations Program* (1997–98) provides administrative information about the diploma examinations for the 1997–98 school year.

This bulletin, the *General Information Bulletin*, and the *Students First* guide are distributed to all senior high school principals and are also available on the Internet at Alberta Education's Web site (http://ednet.edc.gov.ab.ca).

If you have questions or comments about the contents of this bulletin, please contact one of the following persons:

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Important Dates in the 1997–98 School Year

Administration of the Biology 30 Diploma Examination

The diploma examination is designed for a writing time of 2.5 h. Students must be allowed an additional 0.5 h to complete the examination, if required; therefore, examination supervisors must be available for this additional time.

1997–98 Administrations	*Time*
Wednesday, January 28	9:00–11:30 A.M.
Tuesday, April 21	9:00–11:30 A.M.
Thursday, June 25	9:00–11:30 A.M.
Thursday, August 13	9:00–11:30 A.M.

Please consult the *General Information Bulletin, Diploma Examinations Program*, for a complete schedule for all subject areas.

Scoring of the Examination

Scoring of the examination will take place shortly after the administration date.

In early September, the Student Evaluation Branch sends superintendents a letter requesting the names of recommended markers. In this letter, dates for scoring the examination will be announced.

Student Evaluation Branch staff will contact recommended markers before each marking session to confirm participation, and the dates and times for marking.

Notes of Interest

Additional Diploma Examination Administrations

Alberta Education is increasing the number of administrations of diploma examinations to accommodate students' examination needs more effectively. For the 1997–98 school year, in addition to the examinations already offered in January, June, and August, the following diploma examinations will be offered in November and April.

Tuesday, November 4, 1997	9:00–11:30 A.M.	English 30 Part A
		English 33 Part A
Wednesday, November 5, 1997	9:00–11:00 A.M.	English 30 Part B
		English 33 Part B
	1:00–3:30 P.M.	Chemistry 30
Thursday, November 6, 1997	9:00–11:30 A.M.	Mathematics 30
		Mathematics 33
Monday, April 20, 1998	9:00–11:30 A.M.	Social Studies 30
		Social Studies 33
	1:00–3:30 P.M.	Physics 30
Tuesday, April 21, 1998	9:00–11:30 A.M.	Biology 30

The November and April examinations will be available only to students who have school marks in the courses and to individuals having mature student status.

All students must preregister to write diploma examinations in November and April; walk-ins will not be allowed. Students should contact their school principal for application forms and for the location of the nearest writing centre. The application deadlines for the November and April writings are October 10, 1997, and March 26, 1998, respectively.

Data Resources for Students

The Biology 30 diploma examinations contain tear-out data pages. Students should remove the tear-out data pages from the exams at the beginning of the writing session. These pages do not have to be returned with the exam booklets and answer sheets. The data presented are generic for all of the Biology 30 diploma exams provided during a school year; therefore, only some of the data are useful for any particular exam.

Student Use of Scientific Calculators

Examinations are constructed to ensure that the use of particular scientific calculators neither advantages nor disadvantages individual students. Students are expected to provide their own scientific calculators.

Refer to Appendix A for the policy statement on the use of scientific calculators on diploma examinations. Students should be made aware of this policy as early as possible in the school term to ensure they are able to use the scientific calculator of their choice when writing examinations. It is important to clarify with students exactly what they are allowed to have stored in their calculator memories.

Students should also be made aware of the Examination Rules, Grade 12 Diploma Examinations (see the *General Information Bulletin*).

Student Requests for Rescores

Students may request a rescoring of their diploma examinations. Before applying for a rescoring, students should check their *Diploma Examination Results Statement* to find out the distribution of marks. The mark on the machine-scored questions is not likely to change as a result of a rescore, but the written-response mark could change slightly. Students should remember that the rescored mark will be the final mark whether it *increases* or *decreases*.

Students who decide to have an examination rescored must ensure that their application is received before the deadline specified on the results statement. The fee for rescoring each examination is $26.75, which includes GST. If a diploma examination mark is increased by 5% or more as a result of rescoring, the fee is refunded.

Student Requests for Rewriting

Students may rewrite a diploma examination in any regularly scheduled administration. The fee for rewriting each examination is $26.75, which includes GST. Please note that this rewrite fee applies to students repeating the course as well as to those who choose to write the examination. Students must apply to the Student Evaluation Branch by the following dates to be eligible to rewrite the diploma examinations.

Examination Administration	Rewrite Request Deadline
January 1998	November 14, 1997
April 1998	March 26, 1998
June 1998	April 29, 1998

(For more details, see the *General Information Bulletin*.)

Children in Need of Protective Services

If a student who is under 18 years of age indicates in his or her writing that he or she is a victim of physical or sexual abuse, the markers are required *by law* to refer the paper to Social Services. Social Services is required to investigate situations that suggest that children might require protection.

Information for Markers

The written-response questions of the Biology 30 Diploma Examinations are marked by Biology 30 teachers selected from those who have been recommended as markers to the Student Evaluation Branch by their superintendents.

Qualifications

To qualify for recommendation, a teacher must have taught the complete Biology 30 course for two or more years (or four semesters) prior to the current school year, be teaching the course in the current school year, and have an Alberta or Northwest Territories Permanent Professional Teaching Certificate.

Dates for Recommendation

Teachers who wish to be recommended as markers for the diploma examinations should contact their superintendents by the following dates.

Diploma Date	Contact Superintendent by
January 1998	October 01, 1997
June & August 1998	March 01, 1998

Markers for the November and April examinations will be selected from lists of prospective markers submitted by their respective school superintendents.

Criteria for Selection

More teachers are recommended as markers by superintendents than are required by the Student Evaluation Branch for any one marking session. The following criteria are considered when markers are selected for a particular marking session:

- experience as a marker (experienced markers and first-time markers are included)
- regional representation (by zone, jurisdiction, and school)
- student population (proportional representation)

We particularly need teachers who can mark examinations written in French.

Examination Development

As the need arises for teachers to participate in field testing and item writing, letters are sent to superintendents requesting their nominations. Item writing takes place throughout the year and is a vital component of the diploma exam program. Field testing provides students and teachers with the opportunity to become familiar with the nature of questions they will encounter on future diploma exams. Only teachers who have been nominated by their superintendents are eligible to participate in these activities. Therefore, it is essential that teachers who are interested in these activities should contact their superintendents.

Inservices and Presentations

On a limited basis and subject to budget constraints, Student Evaluation Branch staff may be available to provide inservices or presentations related to diploma examinations or the interpretation of diploma examination results.

Other Important Documents

Guide for Students

A publication written for students called *Students First: A Guide for Students Preparing to Write the Biology 30 Diploma Examination* is available in each senior high school and on Alberta Education's Web site (http://ednet.edc.gov.ab.ca). This publication contains suggestions for exam preparation and exam writing suggestions. The Student Evaluation Branch highly recommends that students and teachers examine this document early in the term to prepare for the Biology 30 Examination. Parents will also find this to be a useful publication.

Examiners' Reports

Following the administration of each January and June diploma examination, the Student Evaluation Branch sends copies of the *Biology 30 Examiners' Report* to all senior high schools in Alberta, and also posts it on Alberta Education's Web site (http://ednet.edc.gov.ab.ca).

The *Examiners' Report* contains

- detailed provincial results
- examiners' comments about student performance on the exam
- a detailed blueprint of the examination by reporting category
- the key and difficulty level for all the questions on the examination
- sample questions accompanied by commentary

The *Examiners' Report* provides important information for teachers who wish to interpret their students' results in relationship to provincial results as an ongoing form of program evaluation.

School and Jurisdiction Reports

School and Jurisdiction Statistical Reports are made available to schools and school jurisdictions after each January and June administration of the diploma examinations. These reports are placed on the Dial-In Facility of the Educational Information Exchange and provide detailed information on how well the students in their school and school district, respectively, did on each of the diploma examinations. Teachers may use these data to reflect on the areas of the program where their students did well and those areas where student performance was poor.

Annual Reports

Each year, the Student Evaluation Branch produces the *Annual Report, Diploma Examinations Program.* This report contains information about the results achieved by all students who wrote diploma examinations in the preceding school year. It also contains special studies on topics of interest.

Each of these special studies will be of interest to teachers who are involved in interpreting the diploma examinations results of their students.

Diploma Examinations Program

Year	**Special Studies Topic**
1989–90	Comparing Achievement in Various Diploma Examination Courses
1990–91	Different Paths to Success in Diploma Examination Courses
1991–92	Participation Rates in Diploma Examinations Courses
1992–93	Conventions of Language
1993–94	Participation Rates Over Time
1994–95	Grade 12 Enrollment Decline—A Preliminary Assessment
1995–96	Differential Item Performance Between Males and Females on the June 1996 Administration of the Social Studies 30 Diploma Examination

The 1995–96 Annual Report is available on the Internet at Alberta Education's Web site (http://ednet.edc.gov.ab.ca).

General Information Bulletin

Each September, the Student Evaluation Branch sends all senior high school principals and superintendents copies of the *General Information Bulletin, Diploma Examinations Program*, and also posts it on Alberta Education's Web site (http://ednet.edc.gov.ab.ca). This bulletin provides the information, dates, policies, and rules that apply to the administration of all diploma examinations for the school year.

Teachers and students who have questions about such issues as partial writings, word-processor policy details, special provisions for learning and/or physically disabled students writing diploma exams, dates for exam administration, and definitions of mature students, should consult this bulletin.

Previous Examinations

Previous Biology 30 January and June diploma examinations are posted on the Alberta Education's Web site (http://ednet.edc.gov.ab.ca) and are also available for purchase (@$4.00 + G.S.T.) from the

Learning Resources Distributing Centre
12360-142 Street, Edmonton, AB T5L 4X9
Phone: 403-427-5775 (toll-free 310-0000) Fax: 403-422-9750

Teachers and students who are consulting previous exams should use exams administered under the present *Program of Studies*.

Biology 30 Information

Objectives of the Course

Biology 30 is intended for students who want to better understand the biology principles behind the natural events they experience and the technology they use in their daily lives. Biology 30 is an experimental discipline requiring creativity and imagination. The course is designed for students who are preparing for academic post-secondary studies.

Students of Biology 30 have developed their aptitude for observing, collecting facts, forming generalizations, hypothesizing, and making inferences from observations. They have shown growth in their understanding of biological concepts by their increased ability to apply these concepts to relevant situations. They have learned to communicate in the specialized language of biology.

This growth and development in students has taken place as a result of general education and cognitive maturation. It has been enhanced by science courses, in particular by the successful completion of Science 10 and Biology 20. These courses develop knowledge and skills that are prerequisite to success in Biology 30.

Standards

Students who achieve an *acceptable* standard of performance in Biology 30 receive a final mark of 50% or higher. These students can demonstrate a basic understanding of the nature of scientific inquiry by designing, observing, and interpreting simple laboratory and field investigations. They can readily interpret physiological, genetic, and ecological data that are presented in simple diagrams, tables, and graphs. They can translate word descriptions of biological processes into symbolic representations that facilitate solving simple quantitative genetic and ecological problems. These students can demonstrate an acceptable level of understanding of *equilibrium* by describing how the human nervous and endocrine *systems* regulate other body processes such as reproduction. They can show how environmental and genetic factors regulate *change* in the development of organisms. They can describe how cellular and molecular processes cause *diversity* in organisms. They can illustrate how populations interact with each other, thereby forming communities that over time are in *equilibrium* or a state of *change*. These students recognize and understand key biological and technological terms and therefore can interpret short reports of current biological issues. They can identify the scientific, technological, and societal components of biological problems and explain how these components interrelate in solutions. These students can compose clear and logical descriptive or explanatory statements about major biological issues.

Students who achieve a standard of *excellence* in Biology 30 receive a final mark of 80% or higher. In addition to meeting the expectations for an acceptable standard of performance, these students demonstrate their aptitude and interest in biology and feel confident about their abilities. They can readily interpret interrelated sets of data such as complex graphs and tables. They can analyze and evaluate experimental designs. These students can provide explanations of concepts that are specific but also comprehensive. They can simultaneously apply two or more biological concepts that cross major themes. They can demonstrate a thorough understanding of quantitative relationships and solve multistep numerical problems. When presenting scientific data, they select the most appropriate form. They can analyze complex open-ended issues that are of a new or unique nature. The contexts of these issues would most likely include current investigations of homeostatic mechanisms or current genetic research. These students are aware of a variety of viewpoints relating to the environmental and ethical issues in the field of science and technology. Exceptional students can communicate clearly and concisely, using appropriate scientific vocabulary, and can write compositions.

Examination Specifications

Each Biology 30 diploma examination is designed to reflect the Biology 30 course general learner expectations outlined in the *Biology 20–30 Program of Studies, June 30, Interim 1995, for Senior High Schools*. The general learner expectations are expressed in more detail by the specific learner expectations, which are organized into four units. Some questions on each diploma exam will assess achievement of specific learner expectations. Some questions will be based on the integration of several specific learner expectations.

All examination questions are organized into sets that relate to broad contexts. Therefore, a set of questions may assess students' ability to integrate several general learner expectations (GLEs). All questions will measure achievement of scientific knowledge; some will also measure achievement of skills and/or STS connections.

The 1997–98 Biology 30 diploma examinations are constructed to place the following approximate emphases on the Biology 30 course general learner expectations.

Knowledge	***Emphasis***
The student can show that	
• humans use nervous and endocrine systems to maintain internal equilibrium among their systems while simultaneously interacting and maintaining equilibrium with the external environment	20–25%
• humans and other organisms have chemically regulated reproductive systems, which ensure survival of the species, and can describe how sexually transmitted diseases interfere with human reproductive function	10–15%
• cell differentiation and organism development are regulated by genetic and environmental factors and that natural processes can be changed by using reproductive technologies	5–10%
• cell division in vascular plants and animals promotes growth, genetic continuity, and diversity of organisms; and that genetic traits are inherited and expressed in predictable ways if chromosome segregation, assortment, and crossing over are taken into account	25–30%
• genetic information stored in DNA molecules directs the functions of organisms and that biotechnology can be used to influence genetic expression	10–15%
• gene frequencies within populations determine the composition of communities and that these gene frequencies may reach equilibrium or continue to change over time as populations interact	15–20%

Skills	***Emphasis***
The student can	20–30%

- design, interpret, explain, analyze, and evaluate investigations
- organize data into tables, graphs, and diagrams and predict relationships
- interpret, explain, analyze, and evaluate data to infer relationships
- use appropriate scientific terminology and mathematical language to communicate and explain scientific concepts

Connections Among Science, Technology, and Society (STS)	***Emphasis***
The student can	20–30%

- apply cause-and-effect reasoning to formulate relationships in which scientific evidence shapes or refutes a theory, and explain the limitations of science and technology in answering all questions and solving all problems
- describe and evaluate the design and function of technological solutions to practical problems using scientific principles and theories, and relate the ways in which science and technology advance one another
- evaluate from a variety of perspectives how science and technology are influenced and supported by society, and assess the ability of society to interact responsibly with the environment
- apply the skills and knowledge acquired in Biology 30 to everyday life and to related and new concepts in post-secondary studies of biology

Examination Design

The design of the 1997–98 Biology 30 diploma examinations is as follows:

Question Format	*Number of Questions*	*Percent Emphasis*
Multiple Choice	48	60
Numerical Response	8	10
Written Response	2	30

The machine-scored portion of each examination contains both multiple-choice and numerical-response questions, some of which may be linked together.

Multiple-choice questions are of two types: *discrete* and *context-dependent*. A discrete question stands on its own without any additional directions or information. It may take the form of a question or an incomplete statement. A context-dependent question provides information separate from the question stem. Most of the multiple-choice questions are *context-dependent.*

A particular context may be used for more than one multiple-choice question, one or more numerical-response questions, as well as for one written-response question.

Answers for multiple-choice questions are recorded in the first section of the machine-scored answer sheet, and answers for numerical-response questions are recorded in the second section on the same side of the same machine-scored answer sheet. Answers to the written-response questions are written right in the exam booklet.

Numerical-response questions are of three types: calculation of numerical values, selection of numbered events or structures from a list, and determination of a sequence of events. Specific instructions for recording answers for each type of numerical-response question are provided in the instruction pages of each Biology 30 diploma examination. It should be noted that the correct answer for any one question will not necessarily require use of all four columns in the grid provided on the answer sheet.

The written-response portion of each Biology 30 diploma examination contains two contextual questions: a closed-response question and an open-response question. Each question has a value of 15 percent.

The closed-response question presents a synopsis of a research project. Pertinent data are provided in the form of graphs and/or tables. The several parts of this question require students to demonstrate a variety of science process skills.

The open-response question presents a problem **also based on current research** that requires students to make connections between biological concepts, technology, and/or social issues. Furthermore, an acceptable response will demonstrate good communication skills.

NEW

For the open-response question (Written Response 2), students will be provided a writing space consisting of three blank pages alternating with three lined pages. This writing space will be the same for every Biology diploma examination, beginning with January 1998. This writing space will be in addition to the blank perforated pages provided at the back of every science diploma examination.

Assessment of STS Connections

Students' understanding of the concepts of science are measured by every question on the examinations. In addition, some questions measure the students' development of the skills and thinking processes associated with scientific inquiry. Some questions will measure students' understanding of the interrelationships between science and technology and among science, technology, and society.

Assessment of Communication Skills

Communication skills are assessed most directly in the teacher-scored questions. For the open-response questions, the descriptions used in the holistic scoring guides may include criteria for assessing communication skills along with criteria for the other components. The term *communication skills* includes those processes by which information is exchanged through appropriate conventions. These conventions include:

- words, sentences, paragraphs
- graphs, diagrams
- mathematical formulas, mathematical and chemical equations
- significant digits, units of measurement

Conventions that are considered appropriate for a particular response are subject- and question-specific.

Course Clarifications

NEW

Science and Technology

The development of science is directly related to the development of technology, as is the development of technology related to advances in science. The word "technology" can have many meanings, but in general, the word refers to a way of doing something. This includes the development of new techniques for solving problems. It also includes ideas and their organization for achieving practical purposes. In the context of an examination question, the word technology will include all of these meanings. That is, a technological explanation should include not only identifications and descriptions of equipment (tools, products), but also explanations of how they may be used.

In biology, the science of molecular genetics is an area of active research and rapid growth. The advancement of genetic knowledge parallels the development of technologies that aid the study of DNA and patterns of inheritance.

In the *Biology 30 Program of Studies*, numerous genetic technologies are found in the sections of Knowledge, Skills, and STS Connections. Below is a list of some genetic technologies mentioned in the *Program of Studies*, their descriptions, and their uses. The curriculum emphasis is listed parenthetically. This list is provided as a clarification of genetic technologies that teachers may find useful for themselves and for instruction.

Technology Name	Technology Description	Use of the Technology
Genetic Counselling (STS)	Analysis of risk for genetic disorders in a family. Family histories are used to construct pedigrees that aid in calculating probabilities.	Used to present options available to avoid or reduce possible risks; also used to inform individuals of likelihood of developing late-onset genetic disorders based on family histories.
Genetic screening (STS)	Can involve biochemical tests that identify proteins indicative of certain genotypes. Can also involve complementary DNA probes if the sequences of the normal and mutant gene are known. DNA probes of a sequence complementary to both the normal and mutant alleles are exposed to a person's DNA sample. If both probes bind, then the person is a carrier.	Used to detect genes in people and advise them of their genotype. May aid in decision making.

Gene Bank (STS)	Storage site for the genetic material of a plant or animal species. The storage method varies according to the characteristics of the animal or plant; sometimes cryopreservation is used.	Used to preserve genetic diversity by ensuring a source of genes for endangered species and particular crop plants.
Gene Therapy (generally this term applies to humans only) (STS)	The transfer of genes into the genome of cells. Often uses a "disarmed" viral vector to carry the gene into the targeted host cell.	Used to treat heritable disorders caused by single-gene mutations, such as hypercholesterolemia, adenosine deaminase deficiency (ADA), and cystic fibrosis.
Gene Transfer (generally this term applies to non-human cells) (STS)	The transfer of genes into the genome of cells. Often uses a "disarmed" viral vector to carry the gene into the targeted host cell.	Used to place desired genes into host cells. For example, the human gene for factor IX (a blood-clotting factor) has been introduced into sheep cells, and the human growth hormone gene has been transferred into pig cells. These are often referred to as transgenic organisms.
Restriction enzyme/endonuclease (Knowledge, Skills)	An enzyme derived from bacteria that recognizes a specific DNA sequence and cuts the DNA at that sequence.	Used to cut DNA for the purposes of recombination or for DNA analysis during chromosome mapping or DNA fingerprinting.
DNA ligase (Knowledge, Skills)	An enzyme that can rejoin a broken bond in DNA.	Used to "seal" ends of DNA that have been cut by a restriction enzyme; often used during the process of DNA recombination.
Recombinant DNA technology (Knowledge, Skills)	The process of cutting out DNA from one genome and placing the DNA into another genome.	Used to transform bacteria, for example, so that the bacteria carry a gene from a different species.
Gel Electrophoresis (Skills)	DNA fragments are applied to a gel (often made of agarose). Electricity is used to allow them to penetrate and move through the gel. Smaller DNA fragments move through more easily and thus migrate farther than larger DNA fragments. A sample of proteins are applied to a gel (often made of polyacrylamide). Proteins can be negatively or positively charged, hence an electric current can be used to allow proteins to be first separated by charge and subsequently separated by size.	When combined with staining or X-ray film techniques, the patterns observed are used to determine the presence or absence of particular DNA segments or proteins. Specific bands of DNA or protein can also be retrieved from the gel.

DNA Fingerprinting (STS)	A sample of DNA is cut with restriction enzymes—this produces a number of DNA segments of different lengths. Because each individual has a unique DNA sequence (genome), each individual will have a different number of sites where the enzyme will cut. This results in a unique number and length of DNA segments for each individual. These DNA segments produce a unique banding pattern ("fingerprint") when analyzed using gel electrophoresis.	Used to determine paternity and to provide evidence in court cases. Used in many species to help establish kinship.
Genetic Engineering (STS)	A general term that refers to the alteration of an organism's genome by selectively removing, adding, or modifying DNA.	Used to produce genetically altered organisms that possess desired traits or that lack undesirable traits.
Biotechnology (STS)	A very general term that refers to the use of organisms or biological products for commercial and/or industrial processes.	Since this is such a general term, the specific use of organisms or biological products would have to be described.
Chromosome Mapping (also called linkage mapping or genetic mapping) (STS, Skills, Knowledge)	Recombination frequencies between genes are used to construct a map of a chromosome that places the genes found on that chromosome in a linear order.	Knowledge of genetic distances between genes allows one to calculate the probability of the appearance of recombinant genotypes and phenotypes in offspring.
Gene Map (Knowledge)	Usually refers to the sequence of bases of a single gene and the linear location of mutant sites that exist for that gene.	Knowledge of the different mutant sites of a gene can be recorded efficiently.
Cloning (STS)	The artificial production of genetically identical copies of segments of DNA, genes, or cells. (Note: Cloning is a natural process as well. Many organisms, such as fungi, Aspen, and sea anemones, produce identical copies of themselves.)	DNA or gene clones are used to provide ample amounts of DNA or genes to work with in the laboratory. Cell lines are generally cell clones that are used to study the effects of drugs, etc., on those cells, and to study gene mutations in particular cells.

Science, Technology, and Society

The impact of science (biology) and technology on society (health care, food production, personal decision making, ethics, and public policy) has, for the most part, been very positive. However, as science and technology develops, ethical problems arise. In genetics, the social impact of new genetic developments is becoming more and more apparent. Ethical concerns arising from the use of genetic technologies should be considered. Equally important is a thorough understanding of the scientific basis of the genetics involved. Students should be able to apply their understanding of genetics to help them with their considerations of the use of genetic technologies.

In the *Biology 30 Program of Studies*, numerous genetic technologies are found in the sections of Knowledge, Skills, and STS Connections. A selection of some genetic technologies are described on pages 15 to 17 of this bulletin. For each genetic technology, ethical concerns arise. For example:

> Is the genetic information derived from **genetic counselling, genetic screening,** or **DNA fingerprinting** public or private information?
>
> To whom do the genes in the **gene bank** belong?
>
> Should the genes identified in the **Human Genome Project** be patented by the scientist who located and/or sequenced them?
>
> What are the implications of identifying, locating, and sequencing genes for various human characteristics?
>
> Is the use of viral vectors for **gene therapy/gene transfer** problematic?
>
> Who decides who should be a candidate for **gene therapy**?
>
> Evaluate the possible uses of **DNA clones, cell clones,** or **whole organism clones**.

Issues in Science, Technology, and Society

An issue is a question that has no conclusive, correct answer or solution. As such, possible answers or solutions may raise disagreement about facts and their interpretation, or values and their importance.

The identification of an issue involves citing the question that is the basis of the disagreement. Questions arise when there are disagreements about the explanation of an event or the cause of an event. Questions also arise when there are disagreements about the value of a product or a process and its use in or by society.

The description of an issue includes not only an identification of the question but also some insight into the accuracy, support, and quality of proposed solutions or answers to the question.

Proposed answers or solutions may be based on common knowledge, common sense, personal observations, or reference to a respected or authoritative source. While no certain answers exist for issues, some answers are better or are more valid than others. An excellent description of an issue offers an intellectual analysis of solutions to the issue. An excellent analysis of the issue would be organized, thorough, and intellectually sound, and would be based on scientific information or evidence. Holistic scoring of “issues” and “decision-making” will be guided by these above principles.

Issues can be categorized into many types, two of which are society (societal) and technology (technological) issues. A societal issue results when a question arises about how people should live together or about how society will be (or has been) affected by a product, process, or event. A technological issue results when a question arises about the use of technology. If this use of technology also affects how people live together in a society, then the technological issue is also a societal issue.

Relationships Among Organisms of Different Species

Mitochondrial DNA (and chloroplast DNA) is used to study the relatedness (evolutionary distances) of organisms. It is preferable to use mitochondrial DNA (mtDNA) over nuclear DNA for two reasons. First, mtDNA accumulates random changes about ten times faster than nuclear DNA, so it is more useful in tracking recent events (recent in terms of evolutionary history). Second, mtDNA is inherited maternally, so that the lineage of inheritance can be traced back to one individual, rather than, for example, sixteen grandparents. MtDNA analysis can be used to determine kinship both within a species and between species.

Textbooks Recommended by Alberta Teachers

Cummings, Michael, R. Human *Heredity Principles and Issues.* 4th ed., Belmont, CA: Wadsworth Publishing Company, 1997. ISBN 0-314-09578-0.

Green, N.P.O., et al. *Biological Science 1.* 2nd ed., UK: Cambridge University Press, 1992. ISBN 0-521-3778 4-6.

Green, N.P.O., et al. *Biological Science 2.* 2nd ed., UK: Cambridge University Press, 1992. ISBN 0-521-37785-4.

Guyton, Arthur C. *Textbook of Medical Physiology.* 9th ed., Philadelphia, PA. W.B. Saunders Company, 1996. ISBN 0-7216-5944-6.

Moore, Keith L., and Persaud, P.V.N. *The Developing Human Clinically Oriented Embryology.* 5th ed., Philadephia, PA: W.B. Saunders Company, 1993. ISBN 0-7216-4803-7.

Smith, Robert Leo. *Elements of Ecology.* 3rd ed., New York, NY: HarperCollins Publishers Inc., 1992. ISBN 0-06-046328-7.

One-Marker Scoring System

Each Biology 30 Diploma Examination has two written-response questions, one of which is a closed-response question. The students' answers to this question are scored by one teacher using an analytic scoring guide. Each guide lists criteria required for each mark along with a sample response that meets all the criteria for a score of 12. The following example is taken from the August 1996 Biology 30 Diploma Examination.

Sample Question and Scoring Guide

Use the following summary of a research project to answer the next question.

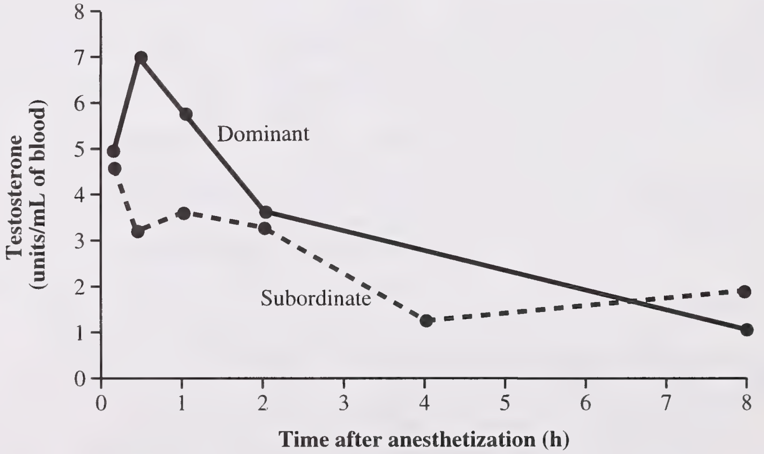
NEW

Stress in the Wild

Research into stress in wild baboons is helping scientists to understand stress in humans. Robert M. Sapolsky has studied baboons on a reserve in Kenya, Africa. These intelligent animals are good substitutes for human subjects because their major source of stress, like that of humans, is not physical, but psychological. Food is plentiful; the baboons spend only a few hours each day feeding. Predators are few and infant mortality (death) is low. With the luxury of plentiful resources and free time, the animals can devote themselves to distressing one another. Sapolsky studied male baboons who are clever at stressing other males. Violence among males is rare, but the threat of violence is always there.

The behaviour of the males was carefully studied in such a way that the researchers were as inconspicuous as possible. Sapolsky designed an experiment to determine the social positions of the males by observing their behaviour over a period of time. He counted how many times a baboon got what he wanted, and these findings were used to place the baboon in a dominant or subordinate category. Dominant males are aggressive. They have an easier time getting food, finding shady spots, and finding mates than do subordinate males. After noting the males' social positions, Sapolsky determined some normal blood hormone levels. He also measured the metabolic effects of the animals being subjected to a physically stressful situation. This stressful situation was brought about in the animals by anesthetizing them with a chemically loaded dart propelled by a blowgun. Before an animal lost conciousness, it was disoriented for a short time, and this seemed to bring on the stress response. Some of the data collected were used in constructing the following graph and diagram.

Average Testosterone Levels in Dominant and Subordinate Male Baboons after Anesthetization



Written Response – 15% (12 marks)

1. **a.** Explain why the researchers wanted to be as inconspicuous as possible when observing male baboons.

1 mark – The researchers wanted to avoid causing unnatural stress (or changes in testosterone or aggression or fear) in the baboons.

b. Before anesthetizing male baboons, the researchers would have considered many variables. Identify **three** of these variables.

Award one mark each for any three of the following:
– up to 1 mark for measurement of responding variable
– up to 1 mark for manipulated variable
– up to three marks for fixed variables

- time of day when darting was done
- time after feeding when darting was done
- activity at time of darting
- apparent health
- season of year when research was conducted
- selection of only mature males to be darted (age)
- size
- amount of anesthetic used
- type of anesthetic used
- point of anatomy where darting occurred
- emotional state of baboons
- apparent social position (dominant or subordinate) – manipulated

Accept any other variables that could be controlled by the researchers.

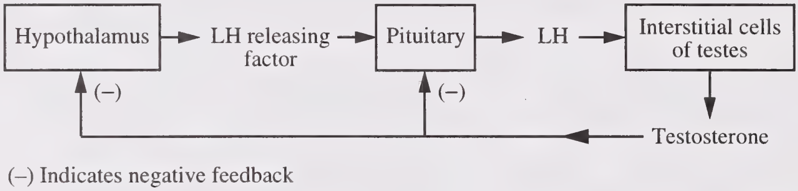
c. i. How did testosterone levels in the anesthetized males differ between dominant and subordinate males in the **one** hour after anesthetization?

1 mark – The testosterone level in dominant males rose then dropped, whereas the testosterone level in subordinate males dropped then rose.
OR
1 mark – The testosterone level was higher in dominant males and lower in subordinate males at the end of the hour.

ii. How might this difference in testosterone levels be advantageous to a dominant male in his natural habitat?

1 mark – In stressful situations, dominant males would be more aggressive **or** stronger **or** more likely to obtain mates **or** more likely to obtain food **or** show other effects related to testosterone (specified).

Hormonal Control of Testosterone Production Without Stress



d. Based on the diagram above, identify one factor that controls the homeostatic level of testosterone.

1 mark – Homeostasis is maintained by the hypothalamus **or** LH releasing factor **or** pituitary **or** LH **or** feedback provided by testosterone level **or** negative feedback.

e. Under stress, dominant males temporarily have more blood flow to the testes. This causes faster delivery of LH to the testes. What response to stress might stimulate this increased blood flow?

1 mark – Increased epinephrine (adrenaline) secretion **or** sympathetic stimulation **or** decreased parasympathetic stimulation may increase the blood flow to the testes.

f. Describe **three** weaknesses in the design of this research project that could affect the reliability of the results.

Award one mark each for any three of the following.
- The presence of the researchers may affect behaviour.
- Stress may not be the only factor that affects testosterone release (e.g., drug interaction).
- The sample size may not have been large enough.
- The researchers studied only one particular group of baboons.
- The study of baboons may not produce data applicable to stress in humans (one gender).
- The reserve presents almost ideal conditions for baboons.
- The definition of dominant and subordinate is subjective.
- Baboon behaviour may not be correctly interpreted/observed by researchers.
- Stress created by darting may differ from normal stress.
- There was no control for the whole experiment.

Accept other reasonable responses.

g. Under prolonged periods of stress, baboons and humans are subject to similar health problems. Identify **one** health problem that baboons under stress are likely to experience.

Award one mark for any of the following:
- hypertension
- nervous/mental disorders
- ulcers
- lowered immunity
- impotence
- eating disorders

Two-Marker Scoring System

The other written-response question is an open-response question. Students' answers to the open-response question are scored by teachers using a holistic scoring guide. The guide describes the characteristics of students' answers that correspond to one of five values: 0, 1, 2, 3, or 4. Each student's answer is scored independently by two teachers. The two scores are added together for a combined total sub-score out of 8.

If the two scores obtained by the two independent readings represent a difference of 2 or more scale categories on the guide, the scores are classified as *discrepant*. Student responses that have *discrepant* scores are read by a third reader. The third reader will assign a score that is within the limits established by the discrepant scores of the first two readers. This score will be multiplied by 2 for a total sub-score out of 8.

The sub-score out of 8 is then prorated out of 12. A summary of the calculations follows:

Reader 1 Score ______ out of 4
Reader 2 Score ______ out of 4
Sub-score ______ out of 8

$$\frac{\text{Prorated Raw Score}}{12} = \frac{\text{Sub-score}}{8} \times 1.5$$

The following example is taken from the January 1997 Biology 30 Diploma Examination.

Sample Question and Scoring of Sample Answers

Use the following information to answer the next question.

NEW

Humans gather information from their internal and external environment, sometimes with the assistance of various technologies. This information is interpreted, integrated, and communicated with appropriate body structures to bring about necessary responses.

Some of these responses maintain an internal equilibrium or homeostasis in the human body. Other responses allow survival in the external world and the ability to deal with stressful situations. In order to respond to any change in the environment (internal and external), the body employs structures called sensory receptors. All receptors function in a similar way: they convert some form of energy into a nerve impulse.

In 1936, Hans Selye, a Canadian endocrinologist, proposed the *general adaptation syndrome*, which describes the human response to stress. One phase of the syndrome is the alarm reaction that prepares the body for fight-or-flight. A second phase of the syndrome is the body's response to long-term stress.

Written Response – 15% (12 marks)

2. Write a **unified** essay that describes **a stressful experience**; explain how the body responds to this stress by addressing the following aspects of neural processing.

- Identify at least **two** sensory organs that respond to external stimuli, and indicate the exact **location** within the organ where the sensory reception takes place. **Trace** the pathway of neural impulses to the brain thereby informing you of the stress.
- Identify **body systems** that are affected by the stressful experience you described. Describe **physiological responses** controlled by these systems that help the body cope with this stress.
- Describe **two** technologies that would assist or enhance sensory perception or help you deal with the stress you described.

Stressful Experience

A student's response should identify a true-life situation (real or imagined) that can be detected with the senses, such as a frightening situation or physical trauma.

Information from External Environment and Pathway to Brain

Organ	Location of Reception	Pathway	Location in Brain of Sense Interpretation
Eye	Retina (rods & cones)	Optic nerve	Occipital lobe
Ear	Cochlea (hair cells) Semicircular canals (hair cells) Vestibule (hair cells)	Cochlear (auditory nerve) Vestibular nerve (sensory neurons)	Primarily temporal lobe Cerebrum Cerebrum
Tongue	Taste buds (taste cells)	Sensory neuron	Parietal lobe (sensory cortex)
Nose	Olfactory epithelium (upper inside surface of nose)	Sensory neuron	Primarily temporal lobe
Skin	Various receptors in skin (pain, temperature, pressure, touch. . .)	Sensory neuron	Parietal lobe (sensory cortex)

Body Systems and Physiological Responses

Nervous system—ANS; the sympathetic nerves are involved

Organ	Physiological Coping Response
• pupil of eye (nervous system)	– dilates
• heart (circulatory system)	– accelerates, increases output, increases blood pressure
• intestine (digestive system)	– decreases movement
• salivary glands (digestive system)	– decreases secretion
• stomach glands (digestive system)	– decreases secretion
• lungs (gas exchange system)	– air passages dilate
• blood vessels (circulatory system)	
gas exchange system	– dilates
heart	– dilates
skin	– constricts
stomach	– constricts
• metabolism (endocrine system)	– increases

Endocrine system—Adrenal medulla produces epinephrine and norepinephrine in response to stress

Organ	**Physiological Coping Response**
• heart (circulatory system)	– accelerates – increases cardiac output – increases blood pressure
• blood vessels (circulatory system)	
skin	– constricts
stomach and intestine	– constricts
reproductive organs	– constricts
muscles	– dilates
• liver (digestive system)	– increases glucose release
• pituitary	– releases ACTH and ADH
• adrenal cortex	– releases cortisol – releases aldosterone
Other hormones released	
• cortisol (ACTH)	– increased blood sugar – supression of immune and allergic responses
• aldosterone (ACTH)	– elevates blood pressure
• ADH	– increases water retention and – increases blood pressure (important in trauma)

Circulatory system – Local constriction of blood vessels or inflammatory response – histamine release

Technology in Sensory Perception

The student's response could include a **description** of at least two of the following topics.

- Hearing aids, audiotapes, sign language, etc., used as aids for the hearing impaired
- Replacing the bones of the middle ear
- Glasses, contact lenses, night-vision glasses (heat sensors/infrared)
- Cornea and/or lens transplants
- Braille books, computers, guide dogs, etc., used as aids for the blind or visually impaired
- Artificial pressure receptors placed in prosthetic devices for the arms and legs

Accept other reasonable descriptions of technologies.

OR

Technology in Coping

The student's response could include a **description** of at least two of the following topics.

- Biofeedback (acupressure, acupuncture) reduces blood pressure, heart rate; increases relaxation
- Medicine (sedative, sleeping pills)
- Medicinal herbs (ginseng, hops, chamomile, lemon balm)
- Exercise (exercise program and relaxation exercises)
- Nutritional therapy (avoiding caffeine, alcohol; eating a diet high in complex carbohydrates)
- Yoga, meditation, and hypnosis
- Diversion type activities (listening to music, etc.)
- Aromatherapy
- Protective clothing to deal with the elements (sunglasses)
- Protective equipment to remove the stress (fire extinguisher)

Accept other reasonable descriptions of technologies.

Holistic Key for Written-Response Question 2

Score	Scoring Description		
	Science	Technology and Society	Presentation
4 **Standard of Excellence** The response addresses all of the major points of the question.	• The response explains sensory reception in two organs. The impulse pathway is traced to a specific region of the cerebrum. • The response describes physiological responses in body systems that help the body cope with stress.	• A stressful experience is described, as are two technologies that either enhance sensory perception or help deal with the stress described.	• Explanations of concepts are clear, concise, logical, and unified. • Complete, grammatically correct sentences are used. • Appropriate scientific vocabulary is used effectively. • Consistency of thought is demonstrated; the response is unified. • The response is well organized.
3 The response addresses most of the major points of the question.	• The response partly explains sensory reception in two organs. The path of impulses is traced to the cerebrum. • The response identifies physiological responses in body systems that help the body cope with stress.	• A stressful experience is described. One technology is described and one other is identified. **or** • Two technologies are described	• Explanations of concepts are clear. • Complete sentences are used. • Some appropriate scientific vocabulary is used. • Consistency of thought is demonstrated; the response is unified. • The response is organized.
2 **Acceptable Standard** The response addresses some of the major points of the question.	• The response explains sensory reception in at least one organ **or** the path of impulses is traced to the brain. • Some physiological responses in body systems are described **or** some body systems are identified.	• A stressful experience is identified. One technology is described. **or** • Two technologies are identified.	• Most explanations of concepts are clear. • Some appropriate scientific vocabulary is used. • Some organizational skills are evident.
1 The response addresses few of the major points of the question.	• The response identifies sensory reception in one organ and the path of impulses is identified. • Some physiological responses in body systems are identified **or** body systems are identified.	• A stressful experience is identified **or** one technology is identified.	• Little appropriate scientific vocabulary is used. • Organizational skills are not evident.
0 The response does not address the major points of the question.	• The response does not describe any of the required scientific principles.	• A stressful experience is not described **nor** is a technology identified.	

Sample Answers

The sample answers for this question were scored by a group of classroom teachers using the scoring criteria on the previous page.

Sample Answer—Score 4

A description of a stressful experience is followed by a correct and thorough explanation of sensory reception in two sensory organs, the eye and the ear. The path of impulses from these two organs is clearly traced to the appropriate regions of the brain. Body systems affected and the responses evoked by the stressful experience are described, although there is only an assumed link to how the responses help a person cope with the stress. Two technologies are well described. Explanations are clear, concise, and logical. Most of the essay is unified, but a link of the technologies with the described stress would have completed the unification. The essay is well organized and shows a consistency of thought. Overall, minor errors do not detract from the essay, and this response represents a score of 4.

A stimulus that forces an adjustment to be made in order to maintain homeostasis is also called a stress. Therefore, in addition to being emotionally stressful, an event such as a bear attack is also a physically stressful experience. Two sensory organs that would initiate the body's response to this particular stress are the eye and the ear.

The eye and the ear both respond to external stimuli by converting a mechanical stimulus into a nerve impulse, which is carried to the brain. Within the eye, sensory reception takes place on the retina (the inner layer of the eye), upon which images are projected and focused. The light entering the eye stimulates the rods and cones, which convert the information into nerve impulses by generating action potentials. Once the nerve impulse is initiated, it travels along the optic nerve (a sensory neuron) until it reaches the association neurons and eventually makes its way to the occipital lobe in the cerebrum of the brain.

Within the ear, sensory reception takes place at the organ of Corti, which is located inside the cochlea (in the inner ear). The stimulus has first been converted from sound waves into vibrations by the tympanic membrane, ossicles, and oval window. When the stimulus reaches the cochlea, it creates waves in the cochlear fluid, and these waves cause the hair cells of the organ of Corti to create an action potential in the auditory nerve. The nerve impulse then travels along the auditory nerve (also a sensory neuron) to the association neurons, and eventually reaches the temporal lobe in the cerebrum of the brain. The nerve impulses from both the eye and the ear travel extremely quickly.

The stressful experience being considered (an attack by a bear) will cause the release of adrenalin. This is regulated by the sympathetic nervous system, which is not under voluntary control. Adrenalin is secreted by the adrenal glands, and prepares the body for the innate "fight or flight" response. This is accomplished by exerting control over several of the body's systems.

Adrenalin causes the pupils to dilate, and the capillaries in the skin to contract. It also causes dilation of the air passages and an increase in heart and breathing rates. Another effect of adrenalin is the release of glycogen from the liver and muscles into the bloodstream as glucose. Adrenalin also causes other, less

Continued

necessary, Body systems (such as the digestive and excretory systems) to cease functioning until the crisis n passed. All of these physiological responses prepare the body to cope with the stressful experience.

There are certain technologies that can assist or enhance sensory perception by organs such as the eye and the ear. Certain conditions, such as astigmatism and myopia can cause the image projected by the lens to be focused somewhere other than on the retina, making the images sent to the brain very unclear. These conditions can often be corrected through the use of laser surgery. This technology alters the shape of the cornea so that the images projected are focused on the retina, as they should be.

A technology that can assist sensory perception by the ear is the cochlear implant. In individuals who have an improperly functioning cochlea, this device can be implanted to assume the duty of converting fluid vibrations into nerve impulses. This permits the individual to perceive sound, which they were previously unable to do.

The body has many systems that function together to cope with crises, each performing certain duties that contribute to the overall effort co-ordinated by the nervous system.

Sample Answer—Score 3

A description of a stressful experience is followed by explanations of sensory reception in two sensory organs, the eye and the ear. These explanations contain some errors, and while impulses are described as travelling to the cerebrum, the path is not clear. Two body systems that would be affected are identified, and responses evoked by the described stressful experience are given, although some confusion about the actual biology of how these systems bring about their effects is evident. One technology is described. Explanations are clear, concise, and logical. Most of the essay is unified but

One night I walked to the store to rent a movie and realized I was being followed. My ears and ears could hear his footsteps and I turned my head nonchalantly to look how far away he was. The sensory receptor in my ~~eyes~~ ears heard the vibrations of his feet and travelled to the tympanic membrane. There the~~y~~ vibrations increased. They moved to the 3 ossicles which are bones so vibrations increased more. They hit the oval window whose flaps create larger vibrations. They are then passed by the cilia hairs in the cochlea. The~~y~~ sounds reached my temporal lobe which processed the information. Unvoluntarily my parietal lobe made be keep walking by its motor cortex.

~~[illegible]~~ The neuronal pathway was much different though. The senory receptors in my eye picked up his shadow. The rods around the fovea centralis was being used. A sensory neuron moved by the impulses from the synapsis. You see you need ans action potential to get the neuron moving from ~~[illegible]~~ its resting membrane. Once it's threshold level is reached it begins to move. The neuron is polarized at the time meaning there are more positive ions on the outside than inside The sodium / potassum a link of the technology with the described stress would have completed the unification. Some errors in the use of scientific vocabulary are present. The essay is organized and demonstrates a consistency of thought. Overall, most of the major points of the questions are addressed, and this response represents a score of 3.

gates open and for every $2K^+$ out, 3^+ Na in. This is depolarization. Then sodium gates close and K^+ gates open. K^+ rushes from a high concentration to a low concentration ~~it is~~ and finally K^+ gate close and Na^+ gate open. It is back to it's polarized state. The neuron is passed through each axon until it reaches the occipital lobe which then process the information.

Once it's info is processed the brain can respond. Two systems are ~~involed~~ involved here, the endocrine and nervous. As we know these two work together through the hypothalmus and the pituitary gland. With the nervous system the hypothalmus sends a message along the sympathetic nerve to the anterior pituitary which then releases ACTH. This hormone then goes to the adrenal medulla which secretes adrenaline. This would enable me to take the fight or flight response. my pupils, ~~res~~ circulatory and skeletal passages would dialate, my heart and breathing rate would increase. I could run very fast and my energy and strength would increase. I could choice to run away or stay and fight.

continued

The endocrine system works slightly different. The pituitary gland secretes ACTH which goes to the adrenal gland which releases cortisol. Cortisol uses stored proteins to make amino acids. This would give me endurance if I needed to run for a long time. The difference between adrenaline / cortisol is the same as Nervous / Endocrine. The nervous is fast acting but short lasting where as endocrine takes a long time to react but lasts longer.

One technology created to release those endorphins is actually viewed as a threat to humans. People created opium and heroin which create similar feeling of tranquility and peace. Many people abuse it as an escape from reality and it can seriously damage one's brain and neuronal pathway.

Sample Answer—Score 2

A stressful experience is identified and followed by an identification of two sensory organs, the eye and the ear. Sensory reception in the eye is not described, but the initial path of impulses is identified. The site of sensory reception in the ear is identified. Some physiological responses evoked by the described stressful experience are given, although how they help a person cope with the stress is not described. Two technologies that would help a person to cope with the stress are described. The explanations, while not complete, are clear. Although the scientific vocabulary is limited, it is used correctly most of the time. The essay is unified and organized. Overall, some of the major points of the question have been addressed, but a lack of thoroughness of the essay results in a score of 2.

Two sensory organs that detect stress are your eyes and eyes. Take this test for example My eyes see the questions the time and sends the message to my brain via the optic nerve at my blind spot that I should be worried. My ears hear nothing except for the odd sniffle and cough at my organ of corti it is transmitted into electrical impulses to my brain. This triggers my memory from previous exams I wrote and found difficult. Now I'm stressed. My heart speeds up, all my blood has rushed to my guts so my hands are cold and sweaty. The kidneys are in overload so I'd really like to pee. This is my fight-or-flight response of my sympathetic nervous system. Obviously I'm fighting. Some things that would help me with all this stress would be to have a trained reflexologist massaging the blood back into my hands and feet and cause my muscles to react. I could take some prescribed drugs to make me feel pleasure, happy but Clueless. I look up and see all the equipment for the gym perhaps exercise would alleviate some of this stress. Last night a sleeping pill would have helped me get a good night sleep for this morning. Breathing exercise which I'm practicing now help me relax. Good, done, SIGH!

Sample Answer—Score 1

A stressful experience is identified, and sensory reception in one organ, the eye, is given but lacks some detail. The path of impulses to the brain is not traced. Some physiological responses evoked by the described stressful experience are described. One technology is identified, and the other is incorrect. The explanations, while not complete, are clear. The use of scientific vocabulary is limited. Some organizational skills are evident. Overall, a few of the major points of the question have been addressed, so this essay represents a score of 1.

There are many aspects of neural processing that helps us deal with stressful situations. An example could be the last 100 m of a race. When you see the finish line in the distance, you all of a sudden feel a surge of energy go to your legs, giving you enough energy for that last stretch. This is accomplished with the help of the pituitary gland, a pea-sized organ located at the base of the brain.

But it all starts with the sensory neurons. The photoreceptors in your eyes see the finish line, stimulating an action potential to begin. A nerve impulse is sent to the brain, where the information is analysed The hypothalamus activates the pituitary gland to produce a hormone called adrenaline.

Adrenaline is released into the blood stream where it goes to autosomal target cells. Heart rate, breathing rate, and blood pressure is increased and the pupils dilate. This is the sympathetic nervous system.

More glucose is sent to your muscles and you have an energy surge. After the goal has been achieved the parasympathetic system kicks in to return the body to normal. All functions are regulated and the medulla oblongata takes control over breathing, heart rate, and blood pressure once again.

If you wanted to enhance these sensory perceptions you could take medication that consists of the hormone adrenaline to propagate these energy surges. In order to deal with these [illegible] stressful situations you could also take medication that consists of noradrenaline, an inhibitor of adrenaline.

Sample Answer—Score 0

A stressful experience is not identified, and although two sensory organs are identified, the locations within these organs where sensory reception takes place are not indicated. The path of impulses to the brain is not traced, and body systems and physiological responses are not identified. Relevant technologies are not identified, in part due to difficulties that arise from not unifying the question with regard to a stress. The use of scientific vocabulary is extremely limited. Overall, none of the major points of the question has been addressed, so this essay represents a score of 0.

The human body responds to stress in many different ways. There are two sensory organs that respond to stimuli. One is the sense of sight, & the other ~~and~~ taste. The exact location within the organ where the sensory reception takes place is, the eyes itself, and the tounge. Two technologies that assist or enhance sensory perception, or help you deal with the stress, are drugs (pills) such as caffiene pills that stimulate the adrenal glands, and speed, which is also a form of drug which allows you to stay constantly giving output.

A body system which is affects, could by the heart.

Appendix A

Calculator Policy

POLICY: USE OF CALCULATORS ON ALBERTA EDUCATION DIPLOMA EXAMINATIONS

Rationale

The knowledge, skills, and attitudes relevant to technology and its uses are being incorporated into courses and programs of study wherever appropriate. Students are expected to learn the advantages and limitations of technology developments and their impact upon society. The ability to use technology helps students understand and appreciate the process of technological change, gives added depth to programs, and provides the basis for the development of skills and understanding. These expectations are reflected in the diploma examination. Since the data provided for writing diploma examinations in mathematics and the sciences do not include information such as logarithms and trigonometric functions, students will need to use scientific calculators for these exams.

Definition

This policy considers a scientific calculator to be a hand-held device designed primarily for mathematical computations. Included in this definition are those scientific calculators having graphing capabilities, built-in formulas, mathematical functions, or other programmable features.

Policy

To ensure compatibility with provincial *Programs of Study* and equity and fairness to all students, Alberta Education expects students to use scientific calculators, as defined above, when they are writing diploma examinations in mathematics and the sciences. Examinations are constructed to ensure that the use of particular models of calculators neither advantages nor disadvantages individual students.

Procedures

1. Teachers must, at the beginning of a course, advise students of the types of calculators that they may use when writing diploma examinations in mathematics and the sciences. Teachers must also advise students of the types of information that can be stored in calculators that are brought into diploma examinations. Calculators that have built-in notes (definitions or explanations in alpha notation) that cannot be cleared are not permitted.

2. Students must clear calculators that are brought into diploma examinations of all information that they have stored except for
    a. programs used for computing values of the formulas on the diploma examination data tear-out pages or in the data booklets
    b. programs used for graphing quadratic relations as found in the Mathematics 30/33 Interim Teacher Resource Manual

3. Students must not bring external devices to support calculators into the exam. Such devices include manuals, printed or electronic cards, printers, memory expansion chips or cards, external keyboards, or any annotations outline operational procedures for scientific calculators.

4. In preparation for calculator failure, students may bring extra calculators and batteries into the exam room.

5. During exams, supervising teachers must ensure that
    a. all calculators operate in silent mode
    b. students do not share calculators or information contained within them
    c. calculator cases are stored on the floor throughout the exam
    d. all examination rules are followed

6. If you have any questions or comments about the implementation of this policy, please contact the Math/Science Unit, Student Evaluation Branch, at 403-427-0010 or FAX 403-422-4200.

Appendix B

Guidelines for Significant Digits, Manipulation of Data, and Rounding in the Science Diploma Examinations

Significant Digits (measured values)

1. For all non-logarithmic values, regardless of decimal position, any of the digits 1 to 9 is a significant digit; 0 may be significant. For example:

   123 0.123 0.00230 2.30×10^3
   all have 3 significant digits

2. Leading zeros are not significant. For example:

   0.12 and 0.012 each have two significant digits

3. Trailing zeros to the right of the decimal are significant. For example:

   0.123 00 and 20.000 each have five significant digits

4. Zeros to the right of a whole number are considered to be ambiguous. **The Student Evaluation Branch considers all trailing zeros to be significant**. For example:

   200 has three significant digits

5. For logarithmic values, such as pH, any digit to the left of the decimal is **not** significant. For example:

   a pH of 1.23 has two significant digits
   a pH of 7 has no significant digits

Manipulation of Data

1. When adding or subtracting measured quantities, the calculated answer should be rounded to the same degree of precision as that of the least precise number used in the computation **if this is the only operation**. For example:

   12.3 (least precise)
   0.12
   12.34
   24.76

   The answer should be rounded to 24.8.

2. When multiplying or dividing measured quantities, the calculated answer should be rounded to the same number of significant digits as are contained in the quantity with the fewest number of significant digits **if this is the only operation**. For example:

   (1.23)(54.321) = 66.81483

   The answer should be rounded to 66.8.

3. When a series of calculations is performed, each interim value should not be rounded before carrying out the next calculation. The final answer should then be rounded to the same number of significant digits as are contained in the quantity in the original data with the fewest number of significant digits. For example:

   In determining the value of (1.23)(4.321)/(3.45 – 3.21), three calculations are required:

   a. 3.45 – 3.21 = 0.24

   b. (1.23)(4.321) = 5.31483

   c. 5.31483/0.24 = 22.145125

      [Not 5.31/0.24 = 22.125]

   The value should be rounded to 22.1.

   Note: In the example given, steps *a* and *b* yield interim values. These values should not be used in determining the number of significant digits.

4. When calculations involve exact numbers (counted and defined values) the calculated answer should be rounded based upon the measured value(s). For example:

   12 eggs × 52.3 g/egg = 628 g

Rounding

1. When the first digit to be dropped is less than or equal to 4, the last digit retained should not be changed. For example:

   1.2345 rounded to three digits is 1.23

2. When the first digit to be dropped is greater than or equal to 5, the last digit retained should be increased by one. For example:

   12.25 rounded to three digits is 12.3

Appendix C

Directing Words

Discuss

The word "discuss" will not be used as a directing word on math and science diploma examinations because it is not used consistently to mean a single activity

The following words are specific in meaning.

Compare

Examine the character or qualities of two things by providing characteristics of both that point out their mutual *similarities* and *differences*

Conclude

State a logical end based on reasoning and/or evidence

Contrast/Distinguish

Point out the *differences* between two things that have similar or comparable natures

Criticize

Point out the *merits* and *demerits* of an item or issue

Define

Provide the essential qualities or meaning of a word or concept; make distinct and clear by marking out the limits

Describe

Give a written account or represent the characteristics of something by a figure, model, or picture

Design/Plan

Construct a plan, i.e., a detailed sequence of actions, for a specific purpose

Enumerate

Specify one by one or list in concise form and according to some order

Evaluate

Give the significance or worth of something by identifying the good and bad points or the advantages and disadvantages

Explain

Make clear what is not immediately obvious or entirely known; give the cause of or reason for; make known in detail

How

Show in what manner or way, with what meaning

Hypothesize

Form a tentative proposition intended as a possible explanation for an observed phenomenon; i.e., a possible cause for a specific effect. The proposition should be testable logically and/or empirically

Identify

Recognize and select as having the characteristics of something

Illustrate

Make clear by giving an example. The form of the example must be specified in the question; i.e., word description, sketch, or diagram

Infer

Form a generalization from sample data; arrive at a conclusion by reasoning from evidence

Interpret

Tell the meaning of something, present information in a new form that adds meaning to the original data

Justify/Show How

Show reasons for or give facts that support a position

Outline

Give, in an organized fashion, the essential parts of something. The form of the outline must be specified in the question; i.e., lists, flow charts, concept maps

Predict

Tell in advance on the basis of empirical evidence and/or logic

Prove

Establish the truth, validity, or genuineness of something by giving factual evidence or logical reasons

Relate

Show logical or causal connection between things

Solve

Give a solution for a problem; i.e., explanation in words and/or numbers

Summarize

Give a brief account of the main points

Trace

Give a step-by-step description of the development

Why

Show the cause, reason, or purpose

Appendix D

Science Process Words

Hypothesis:	A single proposition intended as a possible explanation for an observed phenomenon; e.g., a possible cause for a specific effect
Conclusion:	A proposition that summarizes the extent to which a hypothesis and/or a theory has been supported or contradicted by the evidence
Experiment:	A set of manipulations and/or specific observations of nature that allow the testing of hypotheses and/or generalizations
Variables:	Conditions that can change in an experiment. Variables in experiments are categorized as: • *manipulated variables* (independent variables)—conditions that were deliberately changed by the experimenter • *controlled variables* (fixed or restrained variables) —conditions that could have changed but did not, because of the intervention of the experimenter • *responding variables* (dependent variables)—conditions that changed in response to the change in the manipulated variables

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